Amendment

In response to the Office Action dated February 27, 2001, please amend the application as follows:

IN THE ABSTRACT:

Please substitute the abstract with the following replacement abstract. A marked-up copy of the abstract, showing the change made thereto, is attached.

--A recording medium includes a substrate and an ink-receiving layer provided on the substrate, wherein the ink--receiving layer includes an alumina hydrate having a boehmite structure, an average particle thickness of 2.0 to 6.0 nm and a crystallite size of 5.0 to 8.0 nm in a direction of a (020) plane, and the recording medium has a degree of parallelization of 30 to 1,000.--

IN THE SPECIFICATION:

Please substitute the paragraph starting at page 1, line 5 and ending at line 13 with the following replacement paragraph. A marked-up copy of this paragraph, showing the change made thereto, is attached.

--The present invention relates to a recording medium suitable for use in recording with inks and a production process thereof. In particular, the present invention relates to a recording medium for ink-jet printing, which can provide images high having optical density and bright in

color tone, and has excellent ink-absorbing capacity, a production process thereof, and an image forming process using such a recording medium. --

Please substitute the paragraph starting at page 1, line 14 and ending at page 2, line 5 with the following replacement paragraph. A marked-up copy of this paragraph, showing the change made thereto, is attached.

--In recent years, an ink-jet recording system, in which minute droplets of an ink are ejected by any one of various working principles to apply them to a recording medium such as paper, thereby making a record of images, characters and/or the like, has been quickly spread as a recording apparatus for various images in various applications including information instruments because it has features that recording can be conducted at high speed and with low noise, color images can be formed with ease, recording patterns are very flexible, and development and fixing process are unnecessary. Further, it begins to be applied to a field of recording of full-color images because images formed by a multi- color ink-jet system are comparable in quality with multi-color prints by a plate making system and photoprints by a color photographic system, and such printed images can be obtained at lower cost than the usual multi-color prints and photoprints when the number of copies is small. --

Please substitute the paragraph starting at page 2, line 6 and ending at line 19 with the following replacement paragraph. A marked-up copy of this paragraph, showing the change made thereto, is attached.

With the improvement in recordability such as speeded-up and high-definition recording, and full-coloring of images in the ink-jet recording system, recording apparatus and recording methods have been improved, and recording media have also been required to have higher properties. In order to satisfy such requirements, a wide variety of recording media have heretofore been proposed. For example, Japanese Patent Application Laid-Open No. 55-5830 discloses paper for ink-jet recording, in which a coating layer having good ink absorbency is provided on a surface of a substrate, and Japanese Patent Application Laid-Open No. 55-51583 discloses that amorphous silica is used as a pigment in a coating layer.--

Please substitute the paragraph starting at page 3, line 17 and ending at page 4, line 3 with the following replacement paragraph. A marked-up copy of this paragraph, showing the change made thereto, is attached.

--1. The conventional recording media using pseudo-boehmite have involved a problem that the resulting ink-receiving layer tends to cause haze. In order to cope with this problem, the ink-receiving layer is controlled to have to a specific pore structure as described in Japanese Patent Application Laid-Open No. 2-276670, or to orient a pore structure and boehmite crystals as described in Japanese Patent Application Laid-Open No. 9-30115. However, to lessen pores having a large radius in a recording medium may result in the impairment of ink absorbency, and the uniform orientation of the boehmite crystals has involved a problem that producing conditions are difficult to control.--

Please substitute the paragraph starting at page 5, line 18 and ending at line 24 with the following replacement paragraph. A marked-up copy of this paragraph, showing the change made thereto, is attached.

--According to the present invention, there can be provided recording media which have both an ink solvent- absorbing ability and a coloring material-absorbing ability, permit the choice of inks and coloring materials in a wide range, provide images of even dot diameter, scarcely cause cracking and have excellent water resistance.--

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Please substitute the paragraph starting at page 6, line 21 and ending at page 7, line 8 with the following replacement paragraph. A marked-up copy of this paragraph, showing the change made thereto, is attached.

--A crystal of the alumina hydrate showing a boehmite structure is generally a layer compound the (020) plane of which forms a macro-plane, and shows a characteristic diffraction peak. Besides a perfect boehmite, a structure called pseudo-boehmite and containing excess water between layers of the (020) plane may be taken. The X-ray diffraction pattern of this pseudo-boehmite shows a diffraction peak broader than that of the perfect boehmite. Since perfect boehmite and pseudo-boehmite may not be clearly distinguished from each other, alumina hydrates including both are called an alumina hydrate showing a boehmite structure (hereinafter referred to as the alumina hydrate) in the present invention unless expressly noted.--

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Please substitute the paragraph starting at page 7, line 9 and ending at page 10, line 20 with the following replacement paragraph. A marked-up copy of this paragraph, showing the change made thereto, is attached.

--The present inventors previously proposed a recording medium using an alumina hydrate having a non- crystalline structure or boehmite structure. The present application is an improvement thereof and relates to a recording medium using an ultrahigh orienting alumina hydrate obtained by extremely enhancing the orienting ability of the alumina hydrate having a boehmite structure. When the degrees of orientation and parallelization are determined, this ultrahigh orienting alumina hydrate shows orienting ability extraordinarily higher than the conventional alumina hydrate. It has been found that when a binder is added to the ultrahigh orienting alumina hydrate to form an ink-receiving layer, the resulting recording medium is far improved in resistance to curling before printing, resistance to curling after printing, transparency and resistance to blow marking compared with the conventional recording media, thus leading to completion of the present invention. Since the ultrahigh orienting alumina hydrate has a self-orienting ability like liquid crystal materials, a film can be formed with the alumina hydrate alone without using any binder. By utilizing this nature, the present inventors have also found that when a mixed dispersion containing the ultrahigh orienting alumina hydrate and a binder is applied to a substrate and set like a gelatin material, productivity can be greatly improved, and that the surface defects of an ink-receiving layer formed by applying the dispersion are lessened. The recording media according to the present invention include all of a recording medium in which the ultrahigh orienting alumina hydrate is applied to a substrate to form an ink-receiving

layer, a recording medium in which a coating formulation containing the ultrahigh orienting alumina hydrate is applied to a substrate in a thickness not enough to form a layer clearly, and a recording medium composed of paper made by adding the ultrahigh orienting alumina hydrate into a fibrous material.--

Please substitute the paragraph starting at page 9, line 16 and ending at page 10, line 6 with the following replacement paragraph. A marked-up copy of this paragraph, showing the change made thereto, is attached.

--The shape of an alumina hydrate can be determined by dispersing the alumina hydrate in water, alcohol or the like, dropping the resultant dispersion on a collodion membrane to prepare a sample for measurement, and observing this sample through a transmission electron microscope. As described in literature [Rocek J., et al., Applied Catalysis, Vol. 74, pp. 29-36 (1991)], it is generally known that pseudo-boehmite among alumina hydrates has both a needle form and another form. In the present invention, an alumina hydrate in the form of either a needle or a flat plate may be used. The shape (particle shape, particle diameter, aspect ratio) of the alumina hydrate can be determined by dispersing the alumina hydrate in ion-exchanged water, dropping the resultant dispersion on a collodion membrane to prepare a sample for measurement, and observing this sample through a transmission electron microscope.--

Please substitute the paragraph starting at page 12, line 12 and ending at line 26 with the following replacement paragraph. A marked-up copy of this paragraph, showing the change made thereto, is attached.

--The crystallite size is preferably greater than the average particle thickness or average particle diameter, since the occurrence of bleeding and cissing can be prevented. More preferably, the difference between the crystallite size and the average particle thickness or average particle diameter is at least 1 nm. When the difference satisfies this limitation, the resulting recording medium finds it hard to undergo dusting and cracking when it is folded. The most preferable difference between the crystallite size and the average particle thickness or average particle diameter is at least 2 nm. When the difference satisfies this limitation, the occurrence of beading and a whitish haze on an image printed on the resulting recording medium can be prevented.--

Please substitute the paragraph starting at page 12, line 27 and ending at page 13, line 9 with the following replacement paragraph. A marked-up copy of this paragraph, showing the change made thereto, is attached.

--The term "bleeding" as used herein means that when solid printing is conducted at a fixed area on a recording medium, a portion colored with a dye becomes wider (greater) than a printed area. The term "beading" refers to a phenomenon that a particulate-concentration irregularity appears due to aggregation of ink droplets caused at a solid printed area. The term

"cissing" means that portions not colored occur in a solid printed area. The term "whitish haze" means that an image printed looks hazy white.--

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Please substitute the paragraph starting at page 13, line 10 and ending at page 14, line 5 with the following replacement paragraph. A marked-up copy of this paragraph, showing the change made thereto, is attached.

--The degree of parallelization in the recording medium according to the present invention is within a range of 30 to 1,000. When the degree of parallelization falls within this range, the occurrence of coating defects, curling before printing and curling after printing in the recording medium is prevented. The degree of parallelization is more preferably within a range of 50 to 800, since blow marks are hard to be left on the ink-receiving layer, and the coloring ability of the ink-receiving layer is improved to make a color at a color-mixed area, such as a secondary color, good. In the present invention, the degree of parallelization is determined by subjecting a recording medium and powder thereof to X-ray diffraction to find their respective peaks at a (020) plane and another plane, separately finding an intensity ratio between 2 peaks on both samples and comparing these intensity ratios with each other. No limitation is imposed on the reference peak so far as it has a sufficient intensity that it is not hidden by the peak of the base, like a combined peak of a (200) plane and a (051) plane, or a peak at a (120) plane. The above combined peak is preferred.--

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Please substitute the paragraph starting at page 14, line 6 and ending at page 15, line 19 with the following replacement paragraph. A marked-up copy of this paragraph, showing the change made thereto, is attached.

--In another embodiment of the recording medium according to the present invention, an additional porous layer may be formed on the porous layer comprising the ultrahigh orienting alumina hydrate and a binder. Any material may be used for the upper layer so far as it is a material capable of forming a porous layer. For example, the material can be chosen for use from the group consisting of magnesia, magnesium carbonate, calcium carbonate, silica and silica alumina. Of these, silica is most preferred. When a porous layer containing silica is provided as the upper layer, the ink-receiving layer makes it hard to leave scuff marks on the surface thereof, and moreover the ink-absorbing speed of the ink-receiving layer is increased. As the silica to be used, any of silica sol (colloidal silica) in which primary particles are monodispersed, colloidal particles of silica composed of secondary particles obtained by aggregating primary particles, gel type silica, and precipitated silica may be used. Either a dry process or a wet process may be used as the production of the silica. The shape of the silica used may be either, for example, spherical or non-spherical. No particular limitation is imposed on the particle diameter of the silica. However, it is preferably within a range of from 3 to 200 nm. When the particle diameter falls within this range, the ink absorbency and transparency of the resulting recording medium can be reconciled with each other. Two or more kinds of silica may also be used in combination. In this case, a combination of the inorganic fine particles having a particle diameter of 20 nm or smaller and a particle diameter within a range of from 40 to 200 nm is desirable from the

viewpoints of the prevention of cracking and good transparency. As described in Japanese Patent Application Laid-Open No. 6-183131, silica having a particle diameter of 20 nm or smaller may also be used as a binder. The particle diameter of the silica is more preferably 100 nm or smaller because no surface disorder occurs after printing, and the roundness of printed dots is made better.--

Please substitute the paragraph starting at page 15, line 20 and ending at page 17, line 4 with the following replacement paragraph. A marked-up copy of this paragraph, showing the change made thereto, is attached.

--The BET specific surface area, the pore radius distribution and the pore volume of the ink-receiving layer of the recording medium according to the present invention can be determined by the nitrogen adsorption and desorption method. The BET specific surface area is preferably within a range of from 70 to 300 m^2/g. If the BET specific surface area is smaller than the lower limit of the above range, the resulting ink-receiving layer becomes opaque white, or its adsorption sites to a dye in an ink becomes insufficient, so that the water fastness of an image printed thereon may become insufficient in some cases. If the BET specific surface area is greater than the upper limit of the above range, the resulting ink-receiving layer becomes easy to cause cracking. The ink-receiving layer preferably has a structure that a maximum peak in the pore radius distribution (peak pore radius) thereof is present within a range of from 5.0 to 10.0 nm in radius. When the peak is present within this range, the transparency and ink absorbency of the resulting recording medium can be improved. A more preferred range in radius is a range of from

5.0 to 8.0 nm. When the peak is present within this range, the resolution of an image to be formed on the resulting ink-receiving layer is improved, and the tint of a black ink is kept constant irrespective of concentration. Further, the total pore volume of the ink-receiving layer is preferably within a range of from 0.35 to 1.0 cm^3/g, more preferably from 0.4 to 1.0 cm^3/g because ink absorbency is improved irrespective of the kind of ink. A still more preferred range is a range of from 0.4 to 0.6 cm^3/g. When the total pore volume falls within this range, the tint at a color-mixed area in an image formed is improved. The pore volume of the ink receiving layer is preferably at least 8 cm^3/m^2. If the pore volume is smaller than this limit, inks tend to run out of the ink-receiving layer when multi-color printing is conducted, and so bleeding occurs on an image formed.--

Please substitute the paragraph starting at page 17, line 5 and ending at line 20 with the following replacement paragraph. A marked-up copy of this paragraph, showing the change made thereto, is attached.

--The pore structure and the like of the ink receiving layer are not determined only by the alumina hydrate used, but are changed by various production conditions such as the kind and mixing amount of the binder, the concentration, viscosity and dispersion state of the coating formulation, the coating equipment, the coating head, the coating weight, and the flow rate, and the temperature and blowing direction of drying air. It is therefore necessary to control the production conditions within the optimum limits for achieving the intended properties of the ink-receiving layer according to the present invention. In the present invention, a slurry of the

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alumina hydrate is mixed with a binder without drying the slurry to powder, and the resultant mixture is applied to a substrate, thereby producing a recording medium.--

Please substitute the paragraph starting at page 20, line 4 and ending at line 27 with the following replacement paragraph. A marked-up copy of this paragraph, showing the change made thereto, is attached.

--Although shearing stress applied varies according to the viscosity, amount and volume of the dispersion, it is preferably within a range of from 0.1 to 100.0 N/m^2 (1 to 1,000 dyn/cm^2). When the shearing stress falls within the above range, the viscosity of the alumina hydrate dispersion can be reduced without changing the crystal structure of the alumina hydrate. In addition, the particle diameter of the alumina hydrate can be made sufficiently small, so that binding points between the alumina hydrate, and the binder, substrate and fibrous substance are increased. Therefore, the occurrence of cracking and dusting can be prevented. If the shearing stress exceeds the upper limit of the above range, the dispersion undergoes gelation, or the crystal structure of the alumina hydrate is changed to an amorphous form. If the shearing stress is lower than the lower limit of the above range, dispersion becomes insufficient, so that the resulting dispersion tends to generate precipitate, aggregated particles are left in the resulting recording medium to cause haze, thereby lowering the transparency of the recording medium, and the recording medium tends to cause separation of the particles and cracking.--

A16

Please substitute the paragraph starting at page 21, line 1 and ending at line 17 with the following replacement paragraph. A marked-up copy of this paragraph, showing the change made thereto, is attached.

--Shearing stress ranging from 0.1 to 50.0 N/m^2 is more preferred because the pore volume of the alumina hydrate is not decreased, and moreover aggregated particles of the alumina hydrate can be broken into fine particles, so that the formation of pores having a greater radius in the resulting recording medium can be prevented to prevent separation and cracking of the ink-receiving layer when the recording medium is folded, and the occurrence of haze due to great particles in the recording medium can be reduced. Shearing stress ranging from 0.1 to 20.0 N/m^2 is most preferred because the mixing ratio of the alumina hydrate to the binder in the resulting recording medium can be kept constant to prevent the occurrence of dusting and cracking, and moreover the optical density and dot diameter of dots printed on the recording medium can be made even.--

Please substitute the paragraph starting at page 22, line 10 and ending at line 16 with the following replacement paragraph. A marked-up copy of this paragraph, showing the change made thereto, is attached.

--In the present invention, as a coating process of the dispersion comprising the alumina hydrate in the case where an ink-receiving layer is formed, there may be used a generally-used coating technique using a blade coater, an air knife coater, a roll coater, a brush coater, a curtain coater, a bar coater, a gravure coater, a sprayer or the like.--

Please substitute the paragraph starting at page 23, line 1 and ending at line 17 with the following replacement paragraph. A marked-up copy of this paragraph, showing the change made thereto, is attached.

--Inks used in the image forming process according to the present invention comprises principally a coloring material (dye or pigment), a water-soluble organic solvent and water. As another embodiment, a lipophilic solvent may also be used. Preferable examples of the dye include water-soluble dyes represented by direct dyes, acid dyes, basic dyes, reactive dyes and food colors. However, any dyes may be used so far as they provide images satisfying the required performance such as fixing ability, coloring ability, brightness or clearness, stability, light fastness and the like in combination with the above-described recording media. Carbon black or the like is preferred as the pigment. As a method of using a pigment and a dispersant in combination, a method using a self-dispersing type pigment or a microcapsulizing method may also be used.--

A19

Please substitute the paragraph starting at page 25, line 1 and ending at line 12 with the following replacement paragraph. A marked-up copy of this paragraph, showing the change made thereto, is attached.

--A method for forming an image by applying the above-described inks to the recording medium is performed by an ink-jet recording method. As such a method, any system may be used so far as it can effectively eject an ink from a nozzle to apply it to the recording medium. In particular, an ink-jet recording system described in Japanese Patent Application Laid-Open No.

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54-59936, in. which an ink undergoes a rapid volumetric change by an action of thermal energy applied to the ink, so that the ink is ejected from a nozzle by the working force generated by this change of state, may be used effectively.--

Please substitute the paragraph starting at page 25, line 18 and ending at line 21 with the following replacement paragraph. A marked-up copy of this paragraph, showing the change made thereto, is attached.

--The present invention will hereinafter be described more specifically by the following examples. However, the present invention is not limited to these examples.--

Please substitute the paragraph starting at page 30, line 12 and ending at line 22 with the following replacement paragraph. A marked-up copy of this paragraph, showing the change made thereto, is attached.

--Each recording medium produced was cut into a size of 297 by 210 mm, and solid printing was conducted in an ink quantity of 300 % in the same manner as in the evaluation of ink absorbency with 20-mm blank spaces left at all peripheral sides of the recording medium. The recording medium thus printed was placed on a flat table with the ink-receiving layer turned upward to measure the height of warpage by a height gauge. The resistance to curling of the recording medium was ranked in accordance with the following standard.--